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NEW EXPERIMENTS ON FRICTION, MADE AT METZ, IN 1831, 1832, AND 1833, BY ARTHUR MORIN, CAPT. OF ARTILLERY.

[Continued from page 41.]

Friction of Surfaces after having remained in Contact.—The force necessary to separate surfaces which have remained for some time at rest, has already been mentioned as being greater than the friction of the surfaces in motion.

Fewer experiments were made in this branch of the subject than in the other, but it was ascertained that the same laws regulate both sorts of friction. A few facts not capable of being exhibited in the tabular form may be mentioned in this place.

Nearly all the experiments show greater discrepancies than in the case of bodies in motion, which is in part accounted for by the fact already mentioned, that a slight vibration given to the apparatus will start the sliding body if a weight sufficient to overcome the resistance of friction in motion has been used, or in other words, the friction of separation is equal to the friction of motion when even slight vibrations occur. The author recommends that in all cases of construction the minimum of friction, namely, that of the surfaces when in motion, should be calculated upon, as no structure can be supposed to be free from all vibration. The au-

thor supposes that these vibrations opperate by overcoming the entanglement of fibre produced by a prolonged contact. This conjecture is verrified by another observation that he has made, that vibration does not produce this effect when metals are used, or when the surfaces of wood are thoroughly saturated with water by which the elasticity of fibre is destroyed, and as might be supposed hemp or any other substance not capable of transicoting vibration is also unaffected under the same circumstances.

In some cases a specific cause seems to increase this kind of friction, as when oak rests upon iron. In this instance the gallic acid of the wood acts upon the iron, and produces a gallate of iron which operates both as a cement, and by destroying the polish of the metal. This action is rendered visible by the inky stains of the compound formed. Metals do not appear to have their friction increased by contact to any great degree, that is, it requires little or no more force to start them than to keep them in motion—a remarkable advantage in all machinery into the composition of which they enter.

The use of unguents of any kind appears to have the same effect on this kind of friction, and this is explained by the pressure driving out the excess of unguent and reducing the condition of surface to that denominated *greasy*. Hence in the table the effect of oil, lard, or tallow, will be found nearly the same as that produced by a greasy surface. If there is any difference it is in favor of the harder kind of unguent which cannot be so completely squeezed out by pressure.

These experiments differ from those of Coulomb in assigning a much shorter period for the attainment of the maximum adhesion, while the latter give several days, the former determine a few minutes as the time.

Explanation of the Tables.

The first table contains the number of the results, and has been added for convenience in referring to the table.

The second column contains the names of the substances employed, and the order of position: thus, oak upon iron will be found in one place, and iron upon oak in another. The difference caused by the change in position will be found highly interesting, particularly in the case of the metals.

The third column indicates the nature of the substance applied to the surfaces. For the sake of convenience in reference, we

have abridged the prolixity of the original tables without leaving any thing unexpressed. The values standing at the head of the table are from the first memoir, and were made without any unguent, properly so called. The condition of the surface is denoted by the terms *wet* and *dry*. When the surfaces are said to be *wet*, it is to be understood, that if capable of being thoroughly soaked in water, they are in that condition. In the remaining portion of the table, (taken from the second memoir) the sign 0 denotes a naked or unprepared surface; *water* is to be understood with the same qualification as above; *olive oil*, *tallow* and *lard*, denote these substances in their ordinary conditions. The *dry soap* used, was the best quality of blue Marseilles soap, very hard and dry, and pieces of oak well rubbed with it, and then wiped, showed to a casual observer nothing upon their surface, yet the friction was reduced from ·478 to ·164.

The word *greasy* denotes that state in which surfaces are left after grease has been employed and then wiped off as much as possible. It is evident, as the author observes, that it is not always possible to produce the same amount of unctionity, the results are therefore not entirely comparable, still they are useful as representing the state in which surfaces may be found after having discontinued the use of an unguent for some time.

The fourth column describes the direction of the fibres both mutually and in reference to the direction of motion. It appears that in all cases the fibres of the lower piece were parallel to the direction of motion, so that the terms in this column may be understood as referring to both. Thus *parallel* denotes that the fibres of the sliding body were parallel to those of the one beneath and to the motion; *perpendicular*, that they were at right angles with the fibres beneath and the direction of motion; *vertical*, that the sliding piece of work is placed on end, the rest remaining as before. In the case of a fibrous substance sliding over bronze or cast iron, the reference is of course only to the direction of motion.

The fifth column contains the numerical values expressed decimally; we have retained this form as being the best suited for comparison and calculation. A few of the results, from the first memoir, from 1 to 18, will be found repeated in the remainder of the table with slightly different values. In this case the latter are always to be preferred as the most correct.

TABLE II.

FRICTION OF PLANE SURFACES WHICH HAVE BEEN FOR SOME TIME IN CONTACT.

No.	Nature of Surfaces.	Condition of Surfaces. as to unguent.	Arangement of fibres.	Proportion of friction to pressure.
1	Oak on oak,	Dry,	Parallel	·60 to ·65
2	" "	"	perpendicular,	·54
3	" "	wet,	"	·71
4	elm on oak,	dry,	parallel,	·69
5	" "	"	perpendicular,	.57
6	ash on oak,	"	parallel,	·50 to ·40
7	fir on oak,	"	"	·52
8	beech on oak,	"	"	·53
9	wild pear on oak,	"	"	·44
10	wrought iron on oak,	"	"	·57
11	" " "	"	"	·62
12	service tree,	"	"	·62
13	dressed leather on oak,	"	"	·74
14	rough hide leather on oak,	"	leather flat,	
15	" "	"	leather edgewise,	·43
16	" "	wet	"	·79
17	hempen cords on oak,	dry,	parallel,	·64
18	plat of hemper cords on oak,	"	"	·50
19	cord of hemp $1\frac{1}{2}$ in. diameter,	"	"	·80
20	oak on oak,	dry soap,	parallel,	·440
21	" "	tallow,	"	·164
22	" "	greasy,	"	·390
23	" "	tallow,	perpendicular,	·254
24	" "	greasy,	"	·314
25	" "	0	vertical,	·271
26	beach on oak,	greasy,	parallel,	·330
27	elm on oak,	"	"	·420
28	" "	dry soap,	"	·411
29	" "	tallow,	"	·142
30	hemp on oak,	water,	perpendicular,	·869
31	elm on elm,	dry soap,	parallel.	·217
32	oak on elm,	0	"	·376
33	" "	tallow,	"	·178

No.	Nature of Surfaces.	Condition of Surfaces as to unguent.	Arrangement of fibres.	Proportion of friction to pressure.
34	Wrought iron on oak,	Water,	"	·649
35	" "	tallow,	"	·108
36	cast iron on oak,	water,		·646
37	" "	tallow,		·100
38	" "	olive oil,		·100
39	" "	greasy,		·100
40	" "	lard,		·100
41	copper on oak,	tallow,		·100
42	horn beam on cast iron,	"	parallel,	·131
43	" "	lard,	"	·136
44	hide leather on cast iron	water	leather flat,	·621
45	" "	"	leather edgewise,	·615
46	" "	olive oil,	leather flat,	·122
47	" "	"	leather edgewise,	·127
48	" "	leather grasy, iron wet,	leather flat	·267
49	elm on cast iron	greasy,	parallel,	·098
50	cast iron on cast iron,	0		·162
51	" "	tallow,		·100
52	wrought iron on cast iron	0		·194
53	" "	tallow,		·100
54	" "	olive oil,		·113
55	" "	greasy,		·118
56	steel on cast iron,	tallow,		·108
57	brass on cast iron,	"		·103
58	bronze on cast iron,	"		·106
59	cast iron on wrought iron,	"		·100
60	" "	"		·100
61	wrought iron on wrought iron,	"		·137
62	" "	tallow,		·115
63	bronze on bronze,	olive oil or greasy		·164

For the American Railroad Journal and Mechanics' Magazine.]

COST OF TRANSPORTATION ON RAILROADS—*By. Charles Ellet Jr., Civil Engineer.*

I have never yet seen any formula derived from the experience of active lines, by which the cost of transportation on railroads may be determined with an approach to accuracy. The expenses of maintaining a line of railroad are not all proportioned to the distance travelled by the locomotive engines, nor to the number of tons conveyed; neither are they all independent of these considerations. But the aggregate annual cost is made up of certain items, which are in fact nearly proportioned to the distance run by all the engines; of others which are strictly proportional to the tonnage conveyed; and of others which are nearly or quite independent both of the amount of the trade, and of the distance travelled.

I offer the following rule for the determination of this aggregate, in the belief that every well managed road of ordinary construction, carrying engines of ordinary power, where the transportation is affected at the usual speed, and which accommodates a respectable amount of business, will exhibit results in close agreement with its indications.

This formula is derived from the considerations which follow; and the constant quantities are supplied from the best experience I have been able to obtain from the past management of the public works of this country. In course of time, when the velocity of heavy burthen trains is reduced to 3 or 4 miles per hour, and companies learn to know where and how to economise, it is probable that some of the items may be reduced. But time and experience have yet to decide how much.

I. *Repairs of Road.*—The repairs of a railroad consist of two distinct divisions; the first of which is nearly independent of the amount of the trade, and may be estimated, on the average, at about $500 per mile. The second division is dependent on the amount of the tonnage, and represents the injury done to the road by the passage of one ton of freight. I estimate this wear and tear at $\frac{35}{100}$ of a cent per ton per mile.

II. *Expense of Cars.*—The expense of repairing and renewing the burthen cars is proportional to the distance which they run, or to the tonnage of the line; and may be estimated at $\frac{45}{100}$ of a cent per ton per mile.

III. *The expense of Agents, Conductors, Force at Depots, Breakmen, and Contingencies of all sorts,* is likewise nearly proportional

to the business of the road, and cannot be assumed at less than *six mills* per ton per mile.

IV. *Locomotive Power.*—The expense of repairs and renewals of locomotive engines and tenders, the cost of fuel, and the pay of engine men and firemen, is nearly proportional to the distance run; and may be estimated at 30 cents per mile, travelled by the engines.

How to express the cost of maintaining a line of road, under good management, for one year, let us represent by

N the number of miles run by all the engines in one year;

T the whole number of tons, nett, conveyed one mile; and h the length of the road in miles.

Then, according to the preceding data

$$\tfrac{3}{10}N+\tfrac{14}{1000}T+500\,h$$

will be the aggregate annual cost in dollars (where the business exists exclusively of tonnage) of maintaining the line and its equipage.

If the road accommodates a mixed business of trade and passengers, to obtain the aggregate expense, we must add the term $\tfrac{1}{100}$ P, where P represents the whole number of passengers carried one mile.

This formula takes proper account of the difference of grades; but is not applicable to very short roads,—to roads doing a very inadequate business—by which I mean less business than can be accommodated by one engine of ordinary power—nor to the first four years' operations, while the road, cars and machinery are yet all new.

By applying this rule to the active lines of the country, it will be found that the larger establishments—those which possess a valuable trade, give very similar results. There are none on which the expenses fall within the limit assigned by the formula, excepting, perhaps, one or two which have been recently completed, and on which the expense of renewing the iron, timber, and bridges, and cars, and locomotives, is not yet very sensibly felt. It will be found to suit those cases better a few years hence.

The following translation of a sketch of German railroads has been handed to us by a friend. The list appears to be correct and has been sent to this country as good authority:

[For the American Railroad Journal and Mechanics' Magazine.]

THE RAILROADS IN GERMANY.

1st. *Finished or now constructing.*

1. The Emperor Ferdinand's Northern railroad runs from Vien-

na to Bochnia. The whole length is about 60 German miles, of which 26 miles are almost finished as far as Leipzick. The branch railroads (to Brunn, Olmutz, Stockerau and Troppau,) are altogether, perhaps, 20 miles in length. The principal railroad and the branch to Brun, 23 miles in length, cost 3,765,000 German dollars.

2. The Vienna and Raab railroad, from Vienna, through Baden to Newkirchen, is finished for 8 miles, and projected from Vienna through Bruck and Polyneusidl to Pressburg, a distance of 9 miles, and from Patzneuridl through Wieselbourg to Raab, a distance of 9 miles. The railroad to Gloggnitz is 10 miles in length, of which $6\frac{3}{8}$ miles, running to Neustadt, is double, will cost 4,550,000 German dollars.

3. The Budweis and Linz railroad, 17 miles in length, from there to Gmunden, has cost 1,680,000. Horse powor is used.

4. The Prague and Pilsen railroad is 14 miles in length, is finished only to Lana, $6\frac{7}{8}$ miles in length, and cost 210,000 German dollars. Horse power is used.

5. The Berlin and Potsdam railroad is $3\frac{1}{4}$ miles in length, was built at the expense of 1,378,000 German dollars.

6. The Berlin and Anhalt railroad, running through Wittenberg and Dessau to Kothen, is about 20 miles in length, and cost 4,200,000 German dollars.

7. The Berlin and Frankfort, on the Oder railroad, is $10\frac{1}{2}$ miles in length and the cost is estimated to be 2,200,000 dollars, is not yet finished, but probably will be by the end of 1842.

8. Berlin and Stettin railroad is now building and will be finished in 1843. The whole length is 18 miles, and will probably cost 3,028,000 dollars.

9. The Magdeburg and Leipzick railroad runs through Kothen (connected with the Berlin and Anhalt railroad) and Halle to the boundary of Saxony, $14\frac{1}{2}$ miles in length, and has cost 3,020,000 German dollars.

10. The Upper Silesia railroad commences at Breslau, and runs to New Berun, near the Vistula, where a conjunction is proposed with the emperor Ferdinand's Northern railroad. The whole length is about 28 miles, its construction to Oppeln has already made conconsiderable progress, and these $10\frac{3}{4}$ miles of length are calculated at 1,467,000 dollars.

11. The Rhenish railroad from Cologne through Duren to Aixla Chappelle is $9\frac{4}{16}$ miles long from there to the boundary of Belgium, $1\frac{9}{16}$ mile in length, has cost 5,000,000 dollars, and before it is finished will probably cost 1,567,000 German dollars more.

12. The Dusseldorf and Elberfield railroad 3¾ miles in length, is built at an expense of 1,620,000 dollars.

13. The Nurenberg and Furth railroad, 1 mile in length, has cost 124,770 German dollars.

14. The Munich and Augsburg railroad, 8½ miles long, has cost 2,330,000 dollars.

15. The Saxon and Bavarian railroad, running from Leipzick through Altenbourg to the Bavarian frontier, near Hof, is 9 miles in length, and has 1 mile branch railroad from Werden to Zwickau, will cost about 6,000,000, and will be continued through Lichtenfels and Bamberg to Nuremberg.

16. The Leipzick and Dresden railroad with its continuation to the Prussian frontier, where it joins the Magdebourg and Liepzick railroad is 17 miles long, and has cost about 60,000,000 dollars.

17, The Baden railroad will terminate at Mannheim and Basil. The expense for the whole length of 37 miles, is 9,698,000 German dollars for one track, and for two tracks, 13,138,000 German dollars. The track of ⅔ mile, which was opened 13th Sept. 1840, between Mannheim and Heidelberg has cost 693,000 dollars.

18. The Taunus railroad, which unites Frankfort on the Mayne, through Kastel with Wiesbaden, has a branch railroad on which horse power is used to Bieberick, 5 1-2 miles in length, which cost 1,831,000 dollars.

19. The Brunswick and Harzburg railroad, through Wolfenbuttel and Vienenbourg, is 5¾ miles in length, with a branch from Vienenbourg to Goslar, 1 1-4 mile. The railroad of 1 3-5 mile to Wolfenbuettel, has cost about 250,000 dollars.

20. The railroad running from Hamburg to Bergedorff, a distance of 2 1-10 miles, will be commenced in 1842, and will cost 750,000 German dollars.

It appears from the above account that Germany has already finished railroads to the amount of 175 1-2 German miles, and is now building 166 1-3 miles more. Those finished have cost about 38,940,000 German dollars, or 222,000 dollars per German mile.—[This will be 33,300 Spanish dollars per statute mile.] Those now in progress will cost about 43,357,000 German dollars.

II. Projected railroads, the construction of which is almost certain.

1. The Magdebourg and Oschersleben railroad with a branch to Halberstadt, 6 1-2 miles in length, will, perhaps, cost 1,700,000 dollars. The company is formed—the requisite capital subscribed, and the consent of the government given.

2. The Oschersleben and Wolfenbuettel railroad uniting with the Brunswick and Harzburg railroad, and which the government of Brunswick has permitted to be built, is 6 1-2 miles in length, and will cost about the same sum.

3. The Breslau and Freibourg railroad with a branch 8 1-2 miles in length will cost 2,000,000 dollars. The company is formed, and the capital subscribed, and the consent of the government given.

4. The Rhine and Weser railroad, running from Deutz (Cologne) through Eberfeld to Minden, is not determined upon by government, but named in this division because the necessity for it is such that no doubt is entertained of its construction. It is about 34 German miles in length, and will cost not more than 6,120,000 dollars.

5. The Bonn and Cologne railroad runs a distance of 4 miles and will cost 750,000 dollars. It has the consent of the government for its construction, and a company with the requisite funds.

6. The Nuremberg and Bamberg railroad already decided upon by the Bavarian government, and is the continuation of the Bavarian and Saxon railroad to Bamberg.

7. The Frankfort, Darmstadt and Gresheim railroad, will be constructed by a company chartered by their governments for 2,880,000 dollars, and will be 8 1-2 miles in length.

8. The Chemnitz and Zwickau railroad will be a part of the Saxon and Bavarian railroad, which the company intends to build and it will be 6 miles in length, and will cost, according to the first calculation, 1,400,000 dollars.

9. The Brunswick and Hanover railroad. This railroad forms a part of the great railroad line between Magdebourg and Minden. A contract for its construction has been made between the Prussian, and Hannoverian and Brunswick Governments. The parts of the Magdebourg, Onhersleben and Brunswick railroad already are mentioned, and the Hannoverian part will be about 17 miles in length, and cost 3,230,000 dollars.

10. The Altona and Kiel railroad. Among the projected railroads with the greatest prospect of success is that intended to join the North sea with the Elb, as a company for its construction is chartered and the preparations are made. It will be 13 1-2 miles ln length, and cost 2,794,000 dollars.

III. Railroads, the construction of which is proposed, but in regard to which no certainty exists. Only the most important lines

are named, and the distance is given by the post route from which some slight variations may occur.

1. The railroad from Dresden through Banlzen, Lobau, Gorlitz, Launzlau, Liegnitz to Breslau is 33 miles in length.

2. The railroad from Frankfort, on the Oder to Breslau is 32 miles in length.

3. The railroad from Augsbourg to Nuremberg is 17 miles in length. The construction of this railroad is now certain, and the consent is given by the Bavarian government.

4. The railroad from Augsbourg to Lindau is 18 miles in length.

5. The railroad from Munich to Salsbourg is 17 miles in length.

6. The railroad from Dresden to Prague is 25 miles in length.

7. The railroad from Berlin to Bergedorf (Hamburg) is 34 miles in length.

8. The railroad from Wismar to Boitzemburg is 12 miles in length.

9. The railroad from Vienna Neustadt to Trieste is 80 miles in length.

10. The railroad from Frankfort, on the Mayne, to Kassel is 21 miles in length.

11. The railroad from Kassel through Muhlhausen to Halle is 26 miles in length.

12. The railroad from Kassel through Karlshafen to Hamm is 16 miles in length.

13. The railroad from Heilbronn to Ulm is 16 miles in length.

14. The railroad from Ulm through Illerthal Leutkirch to Friedrickshafen is 14 miles in length. These railroads, 363 miles in length, will cost about 80,586,000 dollars.

IV. Other railroads appear necessary to connect those which are constructed or constructing.

Commerce in Germany, as elsewhere, requires the communication between ports, markets, places of resort, etc. The problem, which the roads, canals and railroads have to solve, is to put these places in connexion with each other, and with other places of commerce in the shortest, most certain and cheapest manner. I place here the railroad lines together, which are necessary to furnish our native country with the means of supplying the present demands of commerce.

Their railroads are—1. From Eirenach to Bamberg, in length 18 miles.

2. From Frankfort, on the Mayne, to Bamberg, in length, 20 miles.

3. From Heidelberg, to Heilbrum, in length, 7 1-2 miles.
4. From Ulm, to Augsbourg, in length, 9 miles.
5. From Prague, to Vienna, in length 40 miles.
6. From Prague, to Nuremberg, in length, 34 miles.
7. From Prague, to Freibourg, in length, 26 miles.
8. From Stockerau, to Salsbourg, in length 34 miles.

Making 139 miles of railroad, which would cost $42,864,000.

When we now bring together the expenses and the length of all German railroads, we find the following results.

1. Finished railroads	$175\frac{1}{4}$	German miles in length, which have cost	Ger.	$38,940,000
2. Constructing "	$166\frac{1}{3}$	" " " "		43,357,000
3. Chartered "	$124\frac{1}{2}$	" " " "		27,240,000
4. Projected "	363	" " " "		80,586,000
5. Junction "	193	" " " "		42,846,000
	$1022\frac{1}{6}$	German miles.	Ger.	$233,969,000

The Prussan railroads are comparatively the dearest and most extravagantly constructed. It appears, also, that most faults are committed there. The Prussian engineers have, among other things, constructed the Berlin and Anhalt railroad, 1 1-2 inch too wide to unite with the railroads from Magdebourg and Leipzick. All merchandise coming from Berlin or Leiprick must be reshipped at Koethen.

For those who might be astonished at this number, or who believe the expenses to be estimated too high, permit me too remark, that in Great Britain the railroads, 382 miles in length, have required a capital of 404,000,000 dollars, and that in the United State 745 German miles are completed, and 1,300 contemplated.

The population of Germany amounts to	39,000,000
Of Great Britain,	18,000,000
Of the United States,	17,000,000

CIRCULAR.

Sir :—I respectfully beg leave to introduce to your notice my new method of using the common flat bar rail with a cast iron chair (which I have recently invented) in the construction and repairs of railroads, with some few remarks on the expenses of repairs of railroads having the flat and edge rails. Also, the advantages of certain kinds of railroad superstructure—*entire* wooden railroads, etc., etc.

It is as follows, viz: A piece of live oak, white oak, or other solid timber is prepared termed a ribbon 5 inches less in length than the plate rail which is to be used, 5 inches wide on the bottom, and 3 inches wide on the top by 2 1-2 inches thick; each end of this ribbon is dove-tailed 2 inches long, by 2 inches wide on the top, and 2 1-2 inches long by 3 inches wide on the bottom. The ribbon is to be mineralized to increase its hardness as well as to prevent it from decaying. The plate rail is then riveted to it (the ribbon) three inches from each end, also at intervals of 8 inches for its whole length.

To secure this rail and ribbon at the *ends*, cast iron chairs are placed in the centre of the string pieces, the required distance apart. The following is the plan of the chair, for a rail 2 1-2 inches wide; length, 9 1-4 inches, 4 1-2 inches wide on the bottom, with a wing on each side 3-4 of an inch wide, the whole length of the chair 3 inches wide on the top, with a ledge or projection 1-2 inch wide rising nearly to the top of the rail to prevent the flange of the car wheel from moving the ends of the rails horizontally. The thickness of the chairs is the same as the ribbon. Through each wing, are holes to receive the spikes or screws required to secure the chairs to the string pieces. In the chair are openings at each end to receive the dove-tailed ends of the ribbons. The chair being fastened to the string pieces or longitudinal sill, the ribbon, with the plate rail riveted to it, is forced into the opening in the chair, leaving the iron rail projecting 2 1-2 inches over the end of the ribbon, and laying on the top and solid part of the chair, and against the ledge or upward protecting projection. It is there secured by a half inch screw with a head similar to a bedstead screw, running through a hole in the plate rail and also through a corresponding one in the chair (a little oblong to allow for expansion and contraction of the rail,) the screw turning into a nut inserted in an opening running horizontally through the chair.

Thus you will perceive that the ends of the *ribbon* being firmly dove-tailed in the chair, with the rail riveted to it, the projecting end of the rail screwed to the chair will effectually prevent the ends of the ribbons from spreading or sinking with the weight of the car wheels, or rising or moving horizontally, also prevent the *end of the rail* from turning up, which often causes much damage and alarm and is a strong objection to the use of the plate rail.

Timber can be selected and mineralized of a size and quantity that would be required for the ribbons of a road, but would be too expensive for longitudinal pieces; the advantage, however, of the plate rail being well secured to ribbons of solid timber, such as live oak, or the better kinds of white oak, must be very apparent, as there would not be that sinking or yielding of the rail and wood, to the weight of the locomotive and cars as is the case on common timber, such as white pine, and other soft woods frequently used with the plate rail, thereby answering in a great measure all purposes of the expensive edge rail. The ribbons and iron rail are to lay on a continuous surface, secured with spikes or screws, at inter-

vals of about 18 inches, to prevent them from spreading *on the curves*, iron dowels, or pins, will extend from the string pieces into the ribbons. The superstructure best adapted to this rail is described in the report of L. O. Reynolds, Esq., Engineer of the Georgia Central Railroad.

The cost of chairs will be about $200 per mile. White oak ribbons, mineralized, with the plate rail rivited to them with spikes and screws, ready to lay down, $300 per mile. Ribbons made of live oak would make an additional cost of $200 per mile. The iron plate rail, 2 1-2 inches wide by 5-8 of an inch thick, at the present prices of iron, would be $1,100 per mile.

Objections have been made against the use of the plate rail, supposing that a road constructed with it costs more for repairs than one with the edge rail. In a published report of the Baltimore and Susquehanna Railroad Company, I have been informed on that part of their road having the plate rail the repairs are said to have been $700 per mile per annum. William E. Bloomfield, Esq., in a recent communication in the American Railroad Journal, has the following: "The Utica and Schenectady railroad has the disadvantage of the light flat bar, which during the last year in *part* caused the extravagant outlay of $65,279 for the repair of roadway, and fixtures equal to $860 per mile." This statement really makes the flat bar rail appear bad enough, without such an assertion as the former; but one moment's reflection with persons having the least experience in the construction or repairs of railroads must make it appear fallacious. To say that there is a difference of $600 per mile per annum, between keeping the plate and edge rail in order, is too absurd for one moment's belief. Why did not this report explain and let the public know that the plate rail, the repairs of which were $700 per mile, was laid on a superstructure that had been built 9 and 10 years, and the edge rail, the repairs of which were only $100 per mile, was laid on entire new superstructure?

One writer in the Journal says, "the transition from the flat bar to the T rail is instantly perceived by all persons in the train as it passes over." I have not the least doubt but such was the fact, and had the new part of the road, alluded to as having the edge rail, been laid with the plate rail, in a proper manner, there would have been the same "transition perceived," for it is very clear that traveling over an old and decayed superstructure, there will not be that uniform and easy movement as over a new and solid one. It should be recollected that all our first railroads being laid with the plate rail, when we had little or no experience in making a superstructure best adapted to it, and which are now nearly decayed, accounts for the great expense of the repairs of this kind of road, and which is very unjustly attributed to the use of the plate rail. Having some experience in building railroad superstructure, and having closely observed the many plans on which they are built, I feel well convinced that the plate rail laid in a proper manner on a superstructure which experience has proved to be the best, need not cost any more for repairs than the edge rail.

I will now make a short extract from the report of Mr. Reynolds, Engineer of the Georgia Central Railroad, and see how the expense of repairs of that road compares with the others above mentioned. He says, "The cost of maintaining the road, as regards repairs and renewals, is a subject of much interest to all persons interested in its success. For the last half year the expenses of this department have been $50 per mile, which will amount to $10,000 per annum for 100 miles. That part of the repairs comprising the preserving of the arrangement of the part of the superstructure, which on most wooden roads forms a very important item in the expenditure, is with us a mere trifle. On ordinary wooden roads the string pieces require renewal as soon as they exhibit symptoms of decay. With our plan they may be suffered to remain with perfect safety until they are almost entirely decayed; as the iron rail and ribbon are placed along the centre; and the string pieces, firmly bedded in the earth, will support the weight of the engine until they absolutely crush under it. But if the flat bar were applied directly to the surface of the string pieces, that surface would require to be kept always sound and solid. This is effected in our plan by replacing the ribbon, which is done at a trifling expense." So it would appear that the cost of the repairs of this road with the plate rail is only $100 per mile per annum—truly some difference between this sum and $700 per mile, the cost of the repairs of the Baltimore and Susquehanna Railroad.

One other objection has been raised to the use of the plate rail, which is, that it requires more power to move a train over this kind of road, than over one with the edge rail. This is certainly true, that is, as that kind of rail has been used, no kind of care being taken to select timber, when it is well known that some kinds of the same timber have a great deal more solidity than others.—In many roads, white pine string pieces and ribbons have been used to lay the plate iron on; timber of this kind must give to the weight of the locomotive and cars, and consequently require more power to propel a train. But select the most solid kinds of oak, hickory, or maple, and secure the rail well to it, and the difference in power required will be so trifling it can hardly be told. The expense, however, in the two kinds of rails, will be very easily perceived, especially when the proposed tariff goes into operation, which will make an additional cost of $3,000 per mile for the edge rail.

The plan of superstructure adopted by Mr. Reynolds, I have been informed, is in use on some of the graded parts of the New York and Erie Railroad. The advantages of this kind of superstructure, in the repairs of railroads which are much decayed, are very great; for when repairs are made on this plan, it is so much new road or superstructure. The common way in which they are made, continually renewing timber "whenever symptoms of decay occur," without any such advantage, always having an indifferent road. A superstructure of this kind can be rebuilt, and the track being kept in use at the same time, passing trains morning, noon,

and night. Further, it can be done by contract, which is admitted by all to be the most economical way of having any kind of labor done.

There are many sections of country where roads with this kind of superstructure might be used to great advantage, without iron, except on curves and inclinations, the locomotives and cars running on the bare wood; and ninety per cent. of the amount that might be expended in their construction would be so much judiciously invested in a proper railroad. Between Chicago and the Illinois river, and between Milwaukee and the lead mines of Wisconsin, they might be made very profitable to the proprietors, and a general benefit to the country, by reducing the present price of transportation two-thirds or three-fourths. Roads of this description are now in use at the coal mines in the western part of this State, and were in general use at the coal and iron mines in England for near a century before iron railroads were introduced. The Penny Magazine has the following on this kind of road: "The regular load of a horse with a cart along the common road was 17 cwt., while on this railroad it was 42 cwt. The advantages so gained appear to have been thought sufficient, and no further economy of power was for some time sought to be obtained. When there were any acclivities or abrupt curves, thin pieces of wrought iron were nailed over those parts of the rail to diminish the resistance opposed to the wheels, and so that one horse could draw 42 cwt., the required maximum of power. No further effort was considered necessary.

To put a railroad on this plan in operation, from the amount of money that could be obtained a sum should be reserved to build the wooden superstructure, and to purchase iron for the curves and inclinations, two or three cheap locomotives and cars; the residue applied to having the best location made that the ground would admit of and the grading of the road. Wherever light cutting or filling occurs, have the grading complete, and the superstructure finally laid. Where there are deep cutting and filling, and timber is convenient, have bents or trussels of any kind of round timber set up on the exact line of the road, and the superstructure placed upon them. Near the cutting have the ground leveled, and a superstructure laid down with iron, (on that part having much ascent or decent, or curves,) such as is eventually intended to be generally used, connecting with the superstructure on the main line of the road. The money applicable to grading should, if possible, be so expended as to leave the inclinations and cuttings together on some one part of the road, having in view, however, to have the longest level on the end of the road where the greatest amount of tonnage would arrive and depart from. As soon as the road is thus completed, have light locomotives placed on the levels of any length, and use horse power on the short levels and inclinations, and as soon as the resources of the Company will allow it, have the inclinations reduced near the business end of the road if there was none more objectionable. The excavations to be carried by cars into

the fillings on a permanent track laid down as the cuttings advance. When completed, remove the iron from the temporary superstructure on the inclinations, and have it permanently laid at the termination of the level, also on the most business end of the road, which will make a proper railroad as far as it will extend. The timber dispensed with on the first inclinations removed may be used in other cuttings as they progress.

Where timber is convenient, this kind of superstructure with ribbons of common hard timber can be well laid down for $1000 per mile. It will last, by the renewal of the ribbons, which is done at a trifling expense, ten years. Lest, from its partial description, it may not be fully understood, I will explain it. Flatted timbers, 12 inches wide on the bottom, 8 inches wide on the top, and 10 inches deep, are bedded in the ground, lengthwise of the road, the requisite distance apart, with flatted cross ties, the ends dovetailed or framed into them, from 4 to 5 feet apart; in the centre of these timbers is placed the ribbon, about 4 inches square, on which the car wheels are to run.

It must be very clear that a work of this description could not be long in operation, more especially between Chicago and the Illinois river, or Milwaukie and the lead mines of Wisconsin, before its profits and credit would be such that all the grading could be completed, and the iron rails laid down, on the most approved plan for the whole distance, and the light locomotives disposed of to companies about building wooden roads, or might be used on branch roads where there was not business or capital to justify or make an iron railroad. I am aware that this plan or project will have its opponents, who will contend that there is more economy in expending whatever amount of money can be obtained for a railway in making it complete as far as it will extend. To this kind of argument I would answer, that $200,000 will make a wooden railroad between the two first points above mentioned, which will reduce the present cost of transportation, as above stated, two-thirds or three-fourths, as one horse can not draw on our common roads more than 10 cwt. That amount of money would not make any thing like a perfect railroad for more than half the distance, consequently would not reduce the present cost of transportation that proportion or anything like it; and it is very questionable whether such an investment would be profitable, or the road in such credit as to procure the necessary funds to complete it for the whole distance. As cheap railroads complete are also objected to, for many contend that no railroad is worth having unless it is constructed at an expense of $15 or $20,000 per mile, I will make an extract from a writer in the Philadelphia American Sentinel, a few weeks since, on the light railroad, who says, "I am informed, from undoubted authority, that the first railroad for coal made in the United States is the one at Mauch Chunk, of nine miles in length, which cost about $3,000 for the superstructure, over which have been transported, at least, 1,200,000 tons, which is perhaps a greater business than any other road in the United States, and on this light road it has been as fully

proved that velocity can be as greatly extended as if it had been ever so heavy, and that was the first road in this or any other country that effected a motion of thirty miles per hour."

Yours respectfully,

M. J. Clark.

Athens, Pa. July 27, 1842.

[From the Civil Engineer and Architect's Journal.]

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

Second Course.—Lecture vi. On the Gauge of Railways.— After some preliminary observations, illustrating parts of the last lecture, and particularly in reference to what was stated respecting the Brighton railway, Mr. Vignoles proceeded to enter on the subject of the breadth or gauge of railway, which he explained to denote the distance between the iron bars which form the track or way. The definition of the gauge of the old tramways, introduced the observation that, from their form being as it were an artificial rut, they were styled by the French *ornieres*, of which the literal translation was, "wheel-rut." The present ordinary railway gauge was 4 ft. 8 1-2 in., and some speculations were made as to the choice of such a particular breadth; and quotations were made from Mr. Wood's *Treatise on Railways* to show that it had been owing to an accidental circumstance—viz. that the first conclusive experiments on the principle of the present locomotive engines had been made on the Killingworth Colliery railway, which was laid to that gauge. In some of the first of the Acts of Parliament for modern railways, it had been made imperative by a special clause to adopt this particular gauge, and many companies submitted quietly to the enactment, thereby preventing all chance of improvement in what was assumed to be perfect *ab initio;* but about six years ago much discussion having taken place as to the proper gauge, this decree was altered, and there is now no limitation in the width of the gauge, which is left entirely to the discretion of the engineer. Now, the consequence is, that although it would be desirable that there should be a standard gauge fixed, yet, so divided have the public been as to what is the right one, that we have at present no less than seven different gauges used throughout the United Kingdom; some of the Scotch lines, for instance, have a gauge of 4 ft. 6 in., and others of 5 ft. 6 in. The Eastern Counties Company have adopted 5 ft. The gauge of the railways in Russia is 6 ft. On the recommendation of the Irish Railway Commissioners, the Belfast and Armagh Railway Company have made their gauge 6 ft. 2 in. On the Great Western Railway the gauge is 7 ft. Now, as much as 18 years ago, Mr. Tredgold, a celebrated and scientific engineer, made the following observations:—" The width between the rails being dependant on the height of the centre of gravity of the loaded carriage, and this again varying with the na-

ture of the load and the velocity, it will be obvious we cannot do better than make the breadth between the rails such, that by disposal of the load, the centre of gravity may be kept within the proper limit in either species of vehicle, whether swift or slow, and it would be desirable that the same breadth and the same stress on a wheel should be adopted on all railways. We would propose 4 ft. 6 in. between the rails for heavy goods, and 6 ft. for lighter carriages to go at greater speed." Now it is remarkable that, during all the discussions that took place with regard to the gauge, this observation was never referred to. When Mr. Brunel broke through that fixed number for the gauge, and adopted another, he gave very strong and sound reasons for so doing; whether he was right in assuming so high a number as seven is questioned by many, but the principle upon which he went was this,—"I have, said he, laid out the line as nearly level as possible; the curves that I have adopted are nearly equivalent to straight lines; I keep the centre of gravity low, by placing the body of the carriage within the wheels, and anticipating greater stability and steadiness, I shall be able to go at a much higher speed, and with much more assurance of safety."—The Irish Commissioners argue thus,—"From the nature of the locomotive engine, its power is so great in proportion to the friction it has to overcome, that it is capable of drawing a load which (even with a greatly increased breadth as compared with common road carriages) extends to a very considerable length, and, in order to reduce this length as much as possible, it is necessary with the present breadth of way to make the wheels run within the frame which supports the carriages; the seats of the passengers are, therefore, placed above the periphery of the wheel, which for the sake of lowering the height of the centre of gravity, is made as small as possible."

One great theoretical objection, therefore, to the narrow gauge, is the increased friction consequent upon the reduction of the diameter of the wheel, since besides what is due to the load, the friction of a wheel, at the axle, may be said to depend upon the proportion of the diameter of the wheel to the diameter of the axle; but, in attempting to carrying out this principle in practice, the axle has sometimes been turned down so small as to produce much greater and more positive inconveniences, and it is very questionable if it be prudent or desirable to make the proportion between the wheel and axle greater than 15 to 1, and which proportion can be obtained with 3 feet wheels. Now, with a 4 feet wheel and a 3 inch axle, the proportion being 16 to 1, it may be well doubted if, on this account alone, the large wheels are worth their greatly increased cost. The commissioners, however, urged that the same carriage room may be preserved, by extending the breadth of bearing of the rails, so as to allow the wheels to run outside the frame, instead of running within it, in which case we can bring the body of the carriage down to the axletree. The gauge may be thus increased from 4 ft. 8 1-2 in. to 6 ft. 2 in.—thus arguing for an increased breadth, that the centre of gravity may be lowered, and

the diameter of the wheels thereby reducing the friction, and increasing the power to overcome the "surface resistance." This is, in other words, getting more leverage: but such an advantage, however, does not apply so much to railways as to common roads, for, on the railway, there is little or no obstacle to be found in the shape of surface resistance, except what are as a few grains of dust compared with the obstacles to be found on the common road, or the deep ruts in a wood, which require very large wheels for the timber wain. "At the same time," continued the commissioners, "the load itself may be reduced in height, the bottom of the carriage, or truck frame, being, in this case, limited by the axletree of the larger, instead of the periphery of the smaller wheel, and, with this reduction of height, the wear and tear will be reduced, and the ease of the motion increased. Moreover, the force to be overcome being less with the same load, we may, by retaining the power of the engine the same, carry a greater load than at present with the same velocity, or, retaining the same load, carry it at a greater velocity by increasing the diameter of the driving wheels of the engine; or, if it be not desirable to increase the velocity, the speed of the piston might be reduced, which would be a great practical advantage; or, lastly, preserving the same load and velocity, the form and weight of the engine may be made less, and, probably, the one or other of these arrangements would be adopted, according to the nature of the traffic on the railway. Thus, in passenger and mail trains, it might be desirable to increase the velocity, whereas, in the carriage of heavy goods, it would be most economical to increase the load." "But (say the commissioners) there is a point which must be attended to, and that is, that the whole of the advantages apply only to level lines." Now the Great Western was thus susceptible of having a wider gauge, since the line was made nearly level, for, as the commissioners observe, "in ascending the various gradients and inclined planes, the load has to be raised in opposition to gravity, and the power necessary to effect this is frequently equal to, or exceeds, that which is employed to overcome the friction, and will remain the same to whatever extent the friction is reduced. To avail ourselves fully of the reduced friction, those planes which cannot be worked by assistant power require to be reduced in their slopes, in the same proportion that the wheels are increased, or, otherwise, that assistant power be applied on proportionably less slopes than according to present practice"—that is to say, that the power of the engine is employed in overcoming the friction of the load, and in raising it up several ascents, and what is gained by increasing the breadth of the railway and making the wheels run outside the frames, is only applicable to the former, the latter remaining the same as before; "and the advantage of the alteration would be overated if this circumstance were not taken into consideration." Thus it is that the additional advantage arising from the diminution of friction is so small, when you come to other than nearly horizontal lines, that the advantage is lost. There is yet another reason for increasing the gauge—viz. that we are en-

abled to construct the machine without being cramped in space for the moving parts, and affording a larger diameter for the boiler; it was this consideration, probably, which first induced practical engineers to pay attention to increasing the gauge above 4 ft. 8 1-2 in. If we had to begin railways again, we should certainly make the gauge wider than 4 ft. 8 1-2 in. In laying out future lines, particularly where the traffic is not great, the point of consideration will be to obtain the greatest advantage at the least expense, and to determine how much the gauge ought to be increased; and Mr. Vignoles stated, that, after having paid a deal of attention to the subject, he gave it as his opinion, that a gauge of six feet would be amply sufficient to satisfy all reasonable conditions. The Irish railway commissioners had observed, "that, at present, the load is seldom equal to the power of the engine, and, this being the case, but little would be gained by a greater breadth of road," with a view only of reducing the resistance, already much inferior to the power by which it is to be overcome, except by allowing an increased speed on the line generally, and on the level planes in particular. With a full and overflowing traffic, there is no doubt it would be advisable to employ the greatest possible breadth of bearing; but, it is useless, or worse than useless, to incur a present expense for a benefit which it is not likely that there will ever be the means of taking advantage of, so that, unless under the circumstances just mentioned—viz. an incessant traffic, Mr. Vignoles thought that a seven feet gauge was over the mark. Mr. Vignoles stated, that the consideration of curves was connected with that of the gauge, that it was a most important element in the consideration of railways and would be taken up in another lecture. The rule given for raising the outer rail, on curves, required the gauge to be included as one element in the calculation, as also the height of the centre of gravity above the rails, which was also contingent on the gauge, as before explained.

[From the Civil Engineer and Architect's Journal.]

INSTITUTION OF CIVIL ENGINEERS.

"*Description of the Iron Skew Bridge across the Regent's Canal, on the Eastern Counties Railway.*" By Edward Dobson, Assoc. Inst. C. E.

This bridge is built with a direct span of 54 ft., at an angle of 79° with the centre line of the canal. The level of the rails is 14 ft. 6 in. above the water, and it is constructed to have a waterway of 44 ft. with a clear headway of 10 ft. above the towing path.

The dimensions of the several parts of the bridge and the mode of putting them together, with the masonry and the cost of the construction, are described in detail, and illustrated by an elaborate working drawing.

As an appendix to this paper a description is given of a bridge over the same canal, on the line of the London and Birmingham railway, on account of the similarity of its construction. The

span of this latter bridge is 50 ft., but being made for two double lines of rails, it was thought expedient to have three main ribs instead of two, as in the former. The details of construction of this bridge are also given, with a drawing of one of the main ribs and its tie-bar.

"*Remarks on the Ravages of the Worm* (*Teredo Navalis*) *in Timber.*" By Robert Davison, M. Inst. C. E.

This communication describes the ravages committed by the "Teredo Navalis" upon the fir piles of the foundations of the old bridge at Teignmouth, five arches of which, after having been built 12 years, fell suddenly; the construction of a new bridge thus became necessary, and it is now in progress under the direction of Messrs. Walker and Burges. The worm is described as entering the wood through a hole not larger than a pin, and perforating the timber in all directions, but chiefly in the direction of the fibre, at the same time increasing the size of the holes even sometimes to an inch diameter; a few of the worms had been found of the extraordinary length of 3 ft. They confine their operations between low water mark and the bottom of the river, showing that they cannot exist out of water.

A specimen of part of a log picked up off Jersey was as much perforated, but in a different manner, the worms having penetrated the wood indiscriminately all over the surface; in some cases leaving in the holes a coat resembling the tail of a lobster about 3 in. in length, which showed that the ravages had been committed by the "Lymnoria Terebrans."

The paper was also accompanied by a specimen of wood sheathing charged with nails, from the bottom of a vessel believed to be about 100 years old, together with some of the worms ("Teredo Navalis") for the purpose of showing the peculiar shape of the head—resembling a pair of forceps, with which they cut away the wood.

"*Description of the Roof of Messrs. Simpson and Co's. Factory.*" By John Boustead, Grad. Inst. C. E.

The truss of this roof is double, consisting of two frames of Memel timber. The principals are fitted into cast iron shoes resting on the walls, with projections let into the wall plates; they taper towards the ridge, and there abut against a cast iron ring piece, through which a wrought iron bolt 1 1-4 in. diameter passes, and answers the purpose of a king-post in supporting the collar-beam. To the under side of this beam is attached a heel and eye-plate, to either end of which are linked bolts passing between the principals, and secured by nuts at the backs of the shoes, thus forming efficient ties to resist the thrust of the principal rafters.

The slate boards are supported by five purlins 4 ft. apart, and abut against a ridge piece resting on the kings.

The span of the roof is 34 ft. 3 in. The pitch is about 3 to 1, and the principals are placed 9 ft. apart.

The scantlings of the principal timbers are:—Principals 9 1-2 by

2 1-2 in., tapering to 6 1-2 by 2 1-2 in.; collar beam 7 by 3 1-2 in.; purlins 6 by 4 in.; wall plates 6 by 4 in.; slate boards 1 in. thick; ridge piece 10 by 2 in.

The principals were sawn out by a template, so as to insure the given taper and the accuracy of the angles of the ends; they were then laid on a horrizontal position placed at the required angle, and the collar beam inserted 1-2 in. deep into each principal, and secured by bolts 7-8 in. diameter; the mode of raising the roof is then described.

Some of the advantages of roofs of this construction are stated to be, economy in materials and workmanship, with lightness and simplicity, and that all sagging of the timbers may be rectified by screwing up the nuts of the kings and shoes.

The truss is recommended for building where lofty apartments or coved ceilings are required, and also for its presenting so few points for the suspension of heavy weights that may subject the timbers to strains for which no provision has been made.

From the examinations that have been made, this roof seems to answer satisfactorily; it has been erected three years and a half, and has sustained heavy falls of snow, but the ridge and rafters have preserved their lines perfectly, and the walls show no signs of having been subjected to undue pressure. The design of the roof is simple, its appearance light, and it may be considered an interesting specimen of the art of simple carpentry assisted by iron work.

A drawing of the truss accompanied the paper.

SUGAR FROM INDIAN CORN.

The Agricultural Society of Ontario county has offered two premiums to induce the trial of making sugar from Indian corn, pursuant to instructions given by a Mr. William Webb, of Wilmington, Del. It is stated that 800 to a 1000 lbs. of good sugar can thus be made from an acre. If so, it would be exceedingly profitable business. The material instructions are as follows:—

"I have felt considerable interest in the plan for the cultivation of sugar in temperate climates and have made many experiments; first upon the beet, and recently upon maize, or Indian corn, in the hope of discovering some mode by which the desired end might be attained. The results from the latter plant have been extremely encouraging. The manufacture of sugar from it, compared with that of beet, offer many advantages. It is more simple and less liable to failure. The machinery is less expensive, and the amount of fuel required is less by one half. The quantity of sugar produced on a given space of ground is greater, besides being of better quality.

The raw juice of maize, when cultivated for sugar, marks 10 degrees, on the saccharometer, whilst the average of cane juice, (as I am informed,) is not higher than 8 deg., and beet juice not over 3 deg. From 9 3-4 quarts (dry measure) of the former, I have obtained 4 pounds 6 ounces of the syrup, concentrated to the point suitable for chrystalization. The proportion of chrystalizable sugar appears to be larger than is obtained from the cane juice in

Louisiana. This is accounted for by the fact, that our climate ripens corn perfectly, while it but rarely if ever happens that cane is fully matured. In some cases the syrup has chrystalized so completely, that less than one-sixth part of molasses remained. This, however, only happened after it had stood one or two months.—There is reason to believe that if the plant were fully ripe; and the process of manufacture perfectly performed, that syrup might be entirely chrystalized without forming any molasses. This perfection in the manufacture cannot, however, be attained with the ordinary apparatus. Without any other means for pressing out the juice than a small hand mill it is impossible to say how great a quantity of sugar can be produced on an acre. The experiments have been directed more to ascertain the saccharine quality of the corn stalk, than the amount a given quantity of ground will produce; but the calculations made from trials on a small scale, leave no room for doubt that the quantity of sugar will be from 800 to 1000 lbs.

Another mode of cultivation to be employed in combination with the first one proposed, consists simply in raising a greater number of plants on the same space of ground. By this plan, all the unfavorable results above mentioned, were obviated, a much larger quantity of sugar was produced and of better quality.

The juice produced by this mode of cultivation is remarkably pure and agreeable to the taste. Samples of the sugar yielded by it are now in the Patent Office, with a small hand mill, by which the stalks were crushed."

* * * * * * *

"The following mode of cultivating the plant, and making the sugar, is the best that can now be offered:

"The kind of soil best adapted to it is so well understood, that no direction on this point is necessary, except that it should be rich, the richer the better; if not naturally fertile, manure must be applied either ploughed in or spread upon the surface, or used both ways, according to the ability of the owner. Nothing can form a better preparation for the crop, than a clover sod well turned under, and harrowed fine immediately before planting.

"Select for seed the largest and best ears of any variety of corn not disposed to throw up suckers, or spread out in branches; that kind most productive in the neighborhood, will be generally the one best adapted to the purpose. The planting should be done with a drilling machine. One man with a pair of horses, and an instrument of this kind, will plant and cover in the most perfect maner, from ten to twelve acres in a day. The rows, (if practicable, let them run north and south,) two and a half feet apart, and the seed dropped sufficiently thick in the row to insure a plant every two or three inches.

"A large harrow made with teeth arranged so as not to injure the corn, may be used to advantage soon after it is up. The after culture is performed with a cultivator, and here will be perceived one of the great advantages of drilling; the plants all growing in lines,

perfectly regular and straight with each other, the horse shoe stirs the earth and cuts up the weeds by every one so that no hand-hoeing will be required in any part of the cultivation.

"It is part of the system of cane planting in Louisiana, to raise as full a stand of cane upon the ground as possible; experience having proved that the most sugar is obtained from the land in this way; as far as my experience has gone, the same thing is true of corn. This point must therefore be attended to, and the deficiencies, if any occur, made up by timely replanting.

"The next operation is taking off the ears. Many stalks will not produce any, but wherever they appear, they must be removed. It is not best to undertake this work to early; as when the ears first appear, they are tender, and cannot be taken off without breaking, which increases the trouble. Any time before the formation of the grain upon them will be soon enough.

Nothing farther is necessary to be done until the crop is ready to cut for grinding. In our latitude, the cutting may commence with the earlier varieties, about the middle of August. The later kinds will be in September, and continue in season until cut off by frost. The stalks should be topped and bladed while standing in the field. They are then cut, tied in bundles, and taken to the mill. The tops and blades, when properly cured, make excellent fodder, rather better it is believed, than any hitherto used; and the residium, after passing the rollers, may be easily dried and used the same way.

"The mills should be made on the same general principle employed in constructing those intended for grinding cane. An important difference, however, will be found both in the original cost, and in the expense of working them. Judging from the comparative hardness of cane and corn stalk, it is believed that one-fourth part of the strength necessary in the construction of a cane mill, will be amply sufficient for corn; and less than one-fourth part of the power will move it with the same velocity. It may be made with three upright wooden rollers, from twenty to forty inches in length, turned so as to run true, and fitted into a strong frame work, consisting of two horizontal pieces sustained by uprights. These pieces are morticed to admit wedges on each side the pivots of the two outside rollers, by which their distances from the middle one may be regulated. The power is applied to the middle roller, and the others are moved from it by means of cogs. In grinding, the stalks pass through on the right side of the middle cylinder, and come in contact with a piece of frame work called the dumb returner, which directs them backwards, so that they pass through the rollers again in the opposite side of the middle one.

"The modern improved machine is made entirely of iron; three horizontal rollers arranged in a triangular form, one above and two below, the cane or stalk passing directly through, receiving two pressures before it escapes. The lower cylinders are contained in a small cistern, which receives the juice. The latter machine is the most complete, the former the least expensive. These mills may be moved by cattle, but for large operations, steam or water power is

preferable. When the vertical cylinders are turned by cattle, the axis of the middle one has long levers fixed across it, extending from ten to fifteen feet from the centre. To render the arms firm the axis of this roller is carried up for a considerable height, and oblique braces of wood by which the oxen or horses draw, are extended, from the top of the vertical axis to the extremities of each of the arms. When horizontal cylinders are propelled by animal power, the upper roller is turned by cogs at one end, which are caught by cogs on a vertical shaft. It is said that in the West Indies, the purest cane juice will ferment in twenty minutes after it enters the receiver. Corn juice has been kept for one hour before boiling, without any apparent injury resulting; but so much delay is not desirable, as it may be attended with bad effects.

LONG LINES OF RAILROAD, AND THE CENTRAL RAILROAD.

It is important to chronicle the growing success of every long line of railroad communication, as thereby affording an encouragement, and inspiring hope to those engaged in similar enterprises. The Western railroad, running from Boston to Greenbush, near Albany, is, we believe, the longest continuous road in the country, and its success was at one time deemed so improbable as to excite for its supporters, ridicule and almost opprobrium, as wasters of public and private means. But what is the result, now that it is completed? Entirely successful! Where are its opponents? They have been constrained to join the number of its friends. The road is 200 miles long, and cost $9,000,000, or on an average $45,000 per mile. To show somewhat of the business done on this road, and its value, we clip the following items from two or three papers before us, which merely give detached views of the success of this enterprise.

From the Boston Daily Advertiser.

Western Flour.—The morning freight train on the Worcester Rail Road, brought 25 long eight wheeled passenger cars, loaded with 1000 barrels of flour. It left Greenbush on the preceding day, and was brought through that day to Worcester, 155 miles.—The evening train also brought a quantity of flour. The passenger train on the Boston and Worcester Railroad, which left town for Worcester after the fire works, carried out 25 cars conveying about 700 passengers.

The following appeared in the Boston Transcript of July 9th.

Extract from a letter dated Springfield, July 6th.

"I have just seen a gentleman from the West, this evening, and from him I learned that the freight train came from Albany this day with 1.668 barrels of flour for the Boston market. The whole weight of the freight, including other matter besides the flour, is 200 tons."

And what has been the effect of this road on Boston? A letter written to one of the New York papers dated Boston, July 9th, 1842, thus speaks of her rail roads, and their influence·

The population is increasing with rapidity. There was a time when it appeared to me that the glory of Boston was departing, and that her streets would soon be like those of old Salem, overgrown with grass. But a change has come over her, and she is now making rapid strides to come up with her sister, New York! What has produced this change? What has made New York what she is? No one can be at a loss for an answer. It is internal improvements, added to her regular intercourse with Europe. Look at Boston—her line of steam packets—her rail roads to the East, West, North and South. Let any one, for a single day, watch the arrival and departure of the cars on the great Western route—thence let him pass to the Eastern depot, and see the intercourse of that direction. Let him then go to the Stonington and Norwich cars; and last, although not least, let him look at the Northern depot and see the trade through Lowell, to the States of New Hampshire and Vermont; he will not then be surprised at the growth of Boston.

As I passed over the line of the Western rail road the other day, I was surprised to see the quantities of merchandise and live stock which we passed from Springfield to this city, while the store houses at the depots on the route were crowded with country produce in like manner as you find them on your noble Hudson.

We cannot, at present, expect like advantages from our railroad. It passes through a different kind of country, a sparse population, through no large towns or villages, and cannot, therefore, for some time, be made as profitable as the Boston and Albany rail road.

We have often heard the doubt expressed as to the ultimate success of the Central Rail Road; we have even heard it condemned as a failure; but such remarks are grossly invidious and unfounded. The affairs of the company are indeed embarrassed, but the road is daily progressing to its completion. It cannot be expected that it would be very profitable until it reached its terminus; because then only would it tap the principal growing and trading portions of the State. We believe that if the road can but be run up to its next station, before the fall, that the freight will be astonishingly increased, and that most of the crop in its vicinity will be sent to market upon the cars. It is unfair, therefore, to pass judgment on this road, until the nearer completion of the work shall have tested its value.

Before it reaches the richer districts of the interior, and until it fairly enters and taps that more fertile and productive region, and makes it tributary to its channel, we cannot tell its value. When it reaches Macon, it will there meet the Monroe Rail Road on the other side, and when that shall be joined to the Western and Atlantic road, and we hope it ere long will, then we shall begin to realize the value of this great and important link, in that great chain of communications, by which, so large a portion of the West and South-west, shall find its sea-board outlet in the port of Savannah. The friends of this enterprise should not suffer themselves to despond; for if they can, as we know they will, surmount present obstacles, they will surely reap a rich reward at last, in the increasing and valuable business of the road, and in the prosperity and advancement

of Savannah! It has been well said, and it should ever be borne in mind, that "the tributary sources of a rail road increase, in a ratio much greater than in proportion to its length, because the longer the road is, the wider the strip of the country whence it draws its tributary sources of revenue. A man will travel 30 miles on the common road out of his way, for the sake of going 100 miles on the rail road, while he would go only 10 miles out of his way, on a common road, for the sake of using 33 miles of rail road. Thus the strip of country tributary to the rail road, increases in length with the length of the road, and in addition to this, it increases in width."—*Georgian*.

RAIL ROAD TOPICS.

Dividends of Massachusetts Roads in July.

	Capital,	Dividend.	Amount.
Worcester,	2,400,000	4 pr, ct.	96,000
Lowell,	1,800,000	4 "	72,000
Nashua,	400,000	4 "	16,000
Taunton,	250,000	4 "	10,000
Eastern,	1,600,000	3 "	48,000
Providence,	1,842,000	3 "	55,260
New Bedford,	400,000	3 "	12,000
	$8,692,000		$309,360

Averaging nearly 7 1-8 per cent. per annum.—*Transcript*,

European Rail Road Items. The emperor of Russia is constructing a rail road between the two principal cities of the empire, St, Petersburg and Moscow—a distance of 500 miles.

The great rail road which is constructing in Austria by a company chartered in 1830, with a capital of seven millions, at the head of which is the Baron Rothschild, of Vienna, is gradually progressing. The work was commenced in April, 1837. In November of that year the first trip was made from Vienna to Wagram, a distance of seven miles. In July, 1839, it was opened as far as Brunn, in Moravia, 91 miles. There are now 180 miles in operation.—Fifty-three miles are now in progress of construction, and the locations are extended many more miles. Few difficulties are found in the route; neither tunnels nor inclined planes have been required to surmount summits;—the steepest grade is 17.6 feet per mile, or 1 in 300, which is their maximum. The curves have no radius shorter than 1,500 feet, The width of the road 12½ feet, the slopes 1½ to 1, Single track, except the first seventeen miles from Vienna. The iron T rail of 40 lb. per yard is used which cost $135 per ton, The superstructure is not let to contractors for fear of not obtaining solid work, but the residue, after the plans are completed, and estimates made, are set up in sections and bid for by contractors, at *so much below the estimates.* The sub-contractors employ females to do a great part of the work, at very low wages.

The cost of this road, single track, has averaged $29,800 per mile, or $33,000 including outfits. The amount expended so far, six millions of dollars, In 1840 the income of the part between Vien-

na and Brunn, $294,172, averaging $3,333 per mile, or ten per cent. on the capital of construction; 228,368 passengers paid $201,561, and 32,180 tons of goods paid $90,063. The expenses were $225,-547 or $2,478½ per mile, leaving $68,625, or 2½ per cent. profit.—The number of miles travelled by all the engines, was 188,100,—at an expense of $1,25 per mile,—of which 52.4 cents was paid for fuel, which has to be brought from a great distance;—coal and coke are used.

The rate of passenger fare, has been 3.16 cents for first class 2.01 for second, 1.58 for third class—and the average 1.77 cents per mile. The charge is now increased one-fourth.

The first 91 miles required 6,012,500 cubic yards of excavations and embankments; 3,708 feet of wooden bridges, the one over the Danube at Vienna being 1,960 feet long, with spans of 60 feet, 488 feet wooden bridges, with stone piers; 24 stone bridges and viaducts having 228 arches of different spans; 116 culverts, 198 road crossings, of which 31 were under, 6 over, and the remainder level with the rail road.

It is estimated that 90,000 oxen, (*cattle we presume is meant,*) are driven annually from the interior of Galatia to market, upon the transportation of which this company calculate, as well as vast travel and traffic from the interior. Experiments have shown that from 100 to 180 oxen can be carried by a train, each car containing 6 to 8, standing sideways, secured by their cars. In this way they are conveyed from Hardish to Vienna, 83 miles, in 7 or 8 hours, without food.

Since sketching the above we have met with the following article from the *Courier Francais.* It affords so comprehensive a view of the progress of rail roads in Central Europe, that we have had it translated.

From the Courier Francais.

An extraordinary emulation has seized upon the German and Sclavonian population beyond the Rhine, in regard to the rapid progress which the construction of rail roads has made in England, Belgium and the United States. The governments of Austria, Prussia, Russia and Central Germany have applied themselves to work, drawing after them the zeal of a population which cannot be estimated at less than 60,000,000. In these countries the projects have not to undergo the tardy movements of representative bodies, and the financial resources not being absorbed by a multitude of contingent or separate schemes can be concentrated upon a single object; in fine, the lines being traced with great economy, and generally on a single track, do not require any great outlay of their capital. These causes must in a few years give to Germany, Poland and Hungary a great net work of railways,

In Austria, Bavaria, Baden and Hanover, the lines which are to traverse their territories are placed under charge of the governments. Saxony and Bavaria have signed a convention, which has for its object, the execution of a line traced across the centre of Germany from Augsburg to Leipsig, and 85 millions of francs have

been appropriated to that purpose by the two governments. Prussia on her side has treated with Brunswic and Hanover, for prolonging to Cologne, the line from Berlin to Magdeburg, and thus to connect the Elbe with the Rhine.

Germany has not a centre to which all the radii of her united schemes might converge and unite (as France has in the city of Paris,) and hence, each of her great powers wishes to have its own separate system, to which the works of the secondary states shall attach themselves. It is thought however of creating an artificial centre, where the great line which shall join the Baltic to Switzerland, in passing from north to south will cross and exchange its transports, with that which will pass from east to west to unite the Danube with the Rhine, and Vienna with Rotterdam. This intermediary point will be Cassel.

The railroad lines executed comprise 1,225 kilometres or 306 leagues, which have cost 144 millions, (470,000 francs per league.) If the line from Leipsig to Dresden and a part of that from Vienna to Brunn be excepted, the German railways have yet but one track; and some of them even, among others the 206 kilometres from Budweis to Gemunden, do not admit locomotives and are subserved by horse power only.

The extent of the lines in the course of construction is estimated at 1,162 kilometres, and their expense at 160 millions francs. There are besides 4,750 kilometres of additional roads projected, The whole system, comprehending thus the Prusso Saxon, and the Austrian projected towards Poland and Lombardy, would thus compose 7,147 kilometres or 1,786 leagues and would cost 852 millions.

The Austrian system has been prosecuted at the north, from Vienna to Olmutz, and at the south from Vienna to Neustadt; it is to be prolonged to Peth by the left bank of the Danube, to Prague via Brunn, and from Prosan where it is arrested, it is to connect with Cracow. Austria intends to extend it moreover towards the Adriatick and also towards Bavaria—but to attain this immense developement, a financial power would be requisite which this government is not at present endowed with.

In northern Germany, there exist only the roads from Francfort to Mayence, from Manheim to Brucksall, from Augsburg to Munich, and from Nuremburg to Furth. Wurtemburg is discussing the construction of a road from Ulm to Heidelburg, and from Ulm to Augsburg; but her project has not yet led to any measure indicative of its execution; and the government seems to be waiting for France to decree the construction of the road from Paris to Strasburg, before entering decisively upon the undertaking.

IRON STEAMBOATS.

A correspondent of the New York Courier furnishes the following notice of the new iron canal steamboats, constructed with Ericson's propeller, which have just been completed:

Captain R. F. Stockton with his characteristic enterprise, has

started a new project, in connection with the great work of transportation; He has had built, in this city, four Iron Boats of about *two hundred and eighty tons burthen,* to go by steam, upon the *Erricson* propeller principle. The boats are, however, rigged schooner fashion, so as to avail themselves of the less costly power of propulsion, whenever the wind shall come in aid of this old fashioned method of getting along. Two of these boats, the *Black Diamond* and the *Vulcan* left the wharf on the North River, opposite the Phœnix works, last Friday, 12 o'clock. Their appearance excited great attention. It fell to my lot, (somewhat accidentally,) to be one of the party on board. The Black Diamond, on board which was Capt. Stockton, (Capt. Erricson being in charge of the Vulcan,) put off, first; and while the steam was being got up in the latter, a circuit was made by the Black Diamond up the North River, when returning the two boats joined company, and amidst the greeting of the bells of steamboats, which was responded to by the letting off of *jets* of steam; and in view of crowds that lined the wharves, and shipping, we ran up the East River a couple of blocks above the Fulton Ferry. Our speed, I estimated at the rate of about six miles the hour, (only about one half of the propellers being submerged,) operating. On our return we ran under the stern of the ship of the line North Carolina, whose ports were filled with the crew; and on whose quarter-deck were the officers and the band of music, the latter playing "Hail Columbia," as a greeting to this new developement of genius and of enterprise.

The impression made upon the thousands who witnessed the movement of these (as to size and color) *brig-of-war* looking boats, was one of force and wonder. They saw the boats dashing the foam up in their prows, their sails brailed to the masts, and the jack flying, but could see no cause for this onward and steady motion, until a sight of the stern was had, when the propellers being half out of water gave signs that they were the instruments of the power, and to them belonged the agency by which this onward motion was given; and the water thrown into foam, testified that no ordinary power was busy with it.

Passing round the North Carolina, a boat was sent off, which took a few of us to the shore, when these boats continued on to Brunswick *en route* to Philadelphia.

The whole of the machinery is at the stern, and occupies not much more space than would an ordinary dining table. It is as simple as beautiful, and sufficient as it is harmonious. There was not the slightest jar felt. In the bow of the boat is the cabin, it is quite a home for a gentleman. *Multum in parvo* would seem to have been studied out to perfection. All the rest of the boat is for stowage.

The advantages that struck me, as peculiar to this contrivance were—the buoyancy of the boat—its durability and strength; the celerity with which coals and produce and merchandise, &c., may be conveyed; its peculiar adaption to canal duty; and its adaption also to river or sea navigation. I shall remark upon but one of these its *peculiar adaption to canal duty.* I noticed the boat in company,

and when in our rear, could see that instead of the water being thrown out, latterly, from the sides, it fell in upon the boat, right and left. This was caused by the action of the propellers, which threw the water backwards in the boat's wake, making a trough or hollow, in the water, at the stern. Upon the known principle that "water will find its level," the tendency of the water forward, and right and left, is to *fall into the cavity at the stern of the boat.* This effectually secures the banks of the canal from the usual action of the water driven forward, and right and left of the bow, in the horse-towing, or any other mode of passing through a canal.

It appears to me that this propeller, for this reason alone, will be adopted in the navigation of all the canals over the whole country. But, through the canal, these boats keep on, indebted to no external aid, to their destination, and when there, should occasion require it, they can move from dock to dock; from one river to the other, or from one port to the other, and that too by the simplest machinery —(for a boy can work it) in the world.

I presume some one will state the draught of water made by these boats when loaded, and enter into other like calculations, such as the cost of fuel per mile, of labour, of ware and tear, &c.

These boats appear to me to do the business at stroke, of just doubling the capacity of the canals—for a canal may be considered as being doubled in its width, when by any arrangement, a boat can be constructed to carry through it, double the tonnage of any other. Capt. Stockton's triumph is complete—and he will be regarded as a public benefactor for this successful experiment. These boats will ply between Philadelphia and New York; New York and Albany: and New York and New Haven.

Artificial Ice.—There was yesterday opened to the public, at the Colosseum, in the Regent's park, an exhibition of the artificial ice, by means of which skating may be enjoyed in all weathers.— The summer's sun cannot melt the patent ice, over which the skater can glide and figure in a ball room costume. The ice glen in the Swiss cottage of the Colosseum is tastefully arranged. It is surrounded by snow clad cliffs and corresponding scenery. The artificial ice is composed of a mixture of salts, which possess the property of quickly crystalizing into a hard body; so that whenever the surface becomes cut up a new face may be made by pouring on a solution of the salt.—*Courer.*

Four passenger cars from the manufactory of Messrs. Davenport and Bridges, at Cambridgport, (Mass.) arrived at Albany, last week, by the Western Railroad. The cars, omnibuses, &c., from the establishment of these enterprising gentlemen, are considered we believe, fully equal to any others in the country; and we are glad that orders are coming in from a distance.

Am. Traveller.

A steam engine was invented by the Marquis of Worcester in 1655.